

## APPENDIX 1. RECOMMENDED CONTENT FOR TSO-C127A INSTALLATION INSTRUCTIONS AND LIMITATIONS

### 1.0 Identification

The seat model and/or part numbers, to which the installation limitations apply, must be listed. This should be identical to what is listed on the TSOA definition.

### 2.0 Items that Affect the Continued Airworthiness of the Article

The following items are components included in the definition of the TSO article. Their inclusion in this document is not as installation limitations, but as reference for the operator. These items are covered in greater detail in *Seat Manufacturer CMM XX-YY-ZZ*.

#### 2.1 Occupant Restraint System

The restraint system part numbers that are approved for use with each seat and the restraint system manufacturer must be specified. Restraint systems that use a part number suffix to specify the color or other characteristics that do not influence the dynamic performance of the seat or restraint system may be listed with a generic suffix (e.g., P/N 123-4567-XX, where "XX" is the generic suffix). A note must be included to explain the generic suffix and the characteristics that the suffix represents.

#### 2.2 Seat Cushions

The seat cushion assembly part numbers that are approved for use with each seat must be specified.

#### 2.3 Replacement/Spare Parts

Continued TSO compliance with regard to the use of replacement or spare parts must be specified. The following text is suggested as acceptable wording for the text to be used in the IIL.

##### Example:

Continued TSO compliance of these seats can be ensured through the use of replacement or spare parts approved by (*Seat Manufacturer*) per CMM (xx-xx-xx.) or an applicable service document approved by the TSO holder. Modifications to the seats without the express written approval of (*Seat Manufacturer*) may void the TSO certification. This includes any physical modifications to cushions or dress covers.

Persons other than the TSO holder can make modifications to the TSO article in accordance with 14 CFR 21.611(c) and Advisory Circular (AC) 21-25A. Changes to seat restraint systems may require additional coordination with the TSO holder for that article.

### 3.0 Installation Limitations

The following items are limitations on the installation of the article that ensure the article continues to meet the requirements of the TSO. These limitations are to be developed based on the data used to demonstrate compliance with the Minimum Performance

Standards (MPS) of the TSO. These installation limitations describe the conditions in which the article was evaluated and found by the TSO holder to meet the TSO.

It is the responsibility of the installer to demonstrate compliance with the applicable airworthiness regulations. These installation limitations provide much of the information necessary to support that demonstration.

Installation of the article in accordance with these installation limitations is, in general, sufficient to make a finding of compliance to the applicable airworthiness regulations. It is expected that on occasion, there will be cases where the installation limitations are not sufficient to make a compliance finding to the applicable airworthiness regulations. Also, installation of the article in accordance with these installation limitations does not grant automatic compliance to all airworthiness regulations affecting seat installations.

If the article is installed in a way that is not consistent with, or "outside", these installation limitations additional substantiation may be required by the installer before a finding of compliance is made to the airworthiness regulations. Installation of the article outside the installation limitations does not necessarily invalidate the original TSO approval. Whether or not the TSO approval remains valid when an article is installed outside the installation limitations is dependent on the language in the installation limitations for the article.

Statements in the installation limitations should be made in terms of how the TSO holder determined the article meets the MPS of the TSO and not in terms of how the article will not meet the MPS of the TSO.

*The following examples concern life vest retrieval for seats installed at a particular pitch, or range of pitches. Specifying the seat pitch is not required to meet the MPS for life vest retrieval in TSO-C127a, but may be documented and approved as part of the TSO at the seat supplier's option.*

Examples:

The following statement:

*"Seat model ABC meets the requirements of this TSO for life preserver retrieval at a minimum seat pitch of 30 inches",*

enables the installer to install the seat at a seat pitch less than 30 inches after demonstrating adequate life preserver retrieval in accordance with the applicable airworthiness regulations without invalidating the original TSO approval. The installer is not required to show that the seat still meets the requirements of the TSO when installed outside the installation limitations – the original TSO approval remains valid. Since there has been no modification of the seat or its installation limitations under the TSO approval, the installer is not required to mark the seat as modified.

Further, the following statement:

*"Seat model ABC meets the requirements of this TSO for life preserver retrieval at a minimum seat pitch of 30 inches. Seat model ABC will not meet the requirements of the TSO for life preserver retrieval if installed at a seat pitch less than 30 inches",*

requires that the installer modify the seat design data before it can be installed at less than a 30 inch pitch. The installer would be required to substantiate the installation at less than a

30 inch pitch in the same way as required in the preceding example. However, in this case a modification to the installation limitations is required to clearly state that an installation at less than 30 inches is permitted under the TSO approval. The modification to the installation limitations requires the seat to be marked as modified.

The modifier is also required to show that the modified seat meets all requirements of the TSO or remove or obliterate the TSO marking. If the installer cannot or chooses not to show that the modified seat meets all the requirements of the TSO then the original TSO approval and its use toward meeting the original type design is no longer valid. A separate type design approval and production approval will be required for the modified seat.

### 3.1 Aircraft Attachments

The aircraft attachments on which the seats can be installed, based on the representative aircraft attachments included in the structural dynamic tests, must be specified. The limitation should also allow alternate installation on attachments shown to be less critical with regard to seat fitting-to-aircraft attachment interface and aircraft attachment strength, if appropriate.

#### Example:

- Track mounted seats  
Seats must be installed on *Airframe Manufacturer* seat track P/N XXXXX (*Supplier* P/N YYYYY), or seat tracks shown to be less critical with regard to seat fitting-to-seat track interface and seat track strength.

The attachments are typically specified by part number or geometry/material definition. In some cases, it may be acceptable to specify a minimum static load requirement which is based on the peak dynamic loads recorded during testing or actual static strength of the representative attachments used in the dynamic tests.

#### Example:

- Hard mounted seats  
Seat must be installed on attachments (including adapter plates) capable of carrying the following static loads (combined) or greater (typical for):

XXXX shear  
YYYY tension

If dynamic testing was not conducted on representative aircraft attachments, the seat attachment reaction load time histories from the structural dynamic tests must be provided with the following statement:

"Seats must be installed on attachments (including adapter plates) capable of reacting the dynamic reaction loads given in AAAAA."

Where AAAAA is either the reference to where the seat attachment reaction load time histories are in the Installation Instructions and Limitations document or reference to the report that contains them. If the reference is to a report, that report must be provided to the installer.

### 3.2 Installation Orientation and Angle

The seat orientation (e.g., forward facing) and installation angle relative to the aircraft longitudinal axis (cant angle) at which the seats may be installed must be specified. As a minimum, an angle of 2° or less (CW or CCW) should always be specified.

Examples:

- Seats must be installed forward facing.
- Seat must be installed forward or aft facing.
- Seats must be installed at an angle of 2° or less (CW or CCW) relative to the aircraft longitudinal axis.
- Seats noted below must be installed at the angle shown, or less, relative to the aircraft longitudinal axis:

<u>P/N</u>	<u>Angle</u>
XXXX	4° CW
YYYY	4° CCW

- Installation walls must have no cant angle.
- Installation walls must have a maximum cant angle of 7.5° for seat installed in a forward facing orientation and a maximum cant angle of 4.3° for seats installed in an aft facing orientation.

Seats designed to be installed on seat tracks that are not in-line and parallel (track break seats) are typically substantiated for specific locations (or range of locations) on specific aircraft. The specific installation(s) for which the seats have been substantiated must be specified.

Examples

- Seat part number XXXXX must be installed on Model 737-600/-700/-800/-900 aircraft with the inboard front stud located at LBL 24.75 and STA 475.95. Seat part number YYYYY must be installed on Model 737-600/-700/-800/-900 aircraft with the inboard front stud located at RBL 24.75 and STA 475.95.
- Seat part number XXXXX must be installed on Model 737-600/-700/-800/-900 aircraft with the inboard front stud located at LBL 24.75, and between STA 465.95 and STA 478.95. Seat part number YYYYY must be installed on Model 737-600/-700/-800/-900 aircraft with the inboard front stud located at RBL 24.75, and between STA 465.95 and STA 478.95.
- Seat part number XXXXX must be installed on seat track locations as shown in Figure A. Seat part number YYYYY must be installed on seat track locations that are opposite to Figure A.  
(Figure A would be a plan view figure of the seat track locations in the test setup showing the forward track-to-aft track relationship for both the inboard and outboard seat legs with regard to angles, offsets, forward/aft distance, etc.)

3.3 Maximum Seat Weight

The maximum seat weight of each seat substantiated under the TSO must be specified. This weight must be developed considering both the static and dynamic requirements of the TSO.

The **maximum certified seat weight** is the maximum allowable weight for the seat with all items contained in the bill of materials installed, including IFE, occupant restraints, and dress covers. It does not include any items the seat installer may add to the seat, such as emergency equipment or literature pocket contents, that are not contained in the seat bill of materials. It must be stated whether or not this weight includes the three percent growth tolerance.

The **maximum installed seat weight** is the maximum allowable weight for the seat with all components and includes all items the seat installer may add to the seat, such as emergency equipment or literature pocket contents. This weight is equal to the minimum total tested seat weight of all static and dynamic tests used for substantiation of the subject seat P/Ns. It must be stated whether or not this weight includes the three percent weight growth tolerance.

The maximum weight, location, and means of attachment of any item that may be installed by the seat installer (life vests, flashlights, literature pocket contents, etc.) must be specified. Means of attachment for items that are stowed in containers need not be specified.

Items that are included in the seat bill of materials but are not included in the TSO approved design (IFE, telephones, etc.) are addressed further in Section 5.3.

### 3.4 Seats Installed in Repetitive Rows

- i. For seats intended to be installed in repetitive rows, seat pitch limitations based on the dynamic testing conducted and life vest stowage requirements of Appendix 1, paragraph 2.1.2 (SAE AS8049A Subsection 3.1.20) must be provided. A number of requirements in the TSO MPS will contribute to this pitch limitation. These include Row-to-Row HIC/Femur Load dynamic testing, seat permanent deformations (static and dynamic), and life vest retrieval. A separate pitch limitation may be given for each requirement. Regardless, the pitch limitation should clearly indicate which requirement has been considered in developing the limitation. This seat pitch limitation may be stated as a minimum seat pitch, a seat pitch range, or a list of specific seat pitches, depending on the amount of data available.

The requirements for each limitation are defined as follows:

HIC/Femur Load: Seat pitches or pitch range that the seat can be installed at for which HIC not exceeding 1000 and Femur Load not exceeding 2250 lb has been demonstrated.

Seat Deformations: The minimum seat pitch the seat can be installed at and still maintain a 6 inch clearance between seat rows with the critical seat deformations applied (reference AC 25.562-1A, Appendix 2, paragraph 2.a. and Figure 1).

Life Vest Retrieval: The minimum seat pitch the seat can be installed at for which life vest retrieval has been demonstrated per the requirements of SAE AS8049 Subsection 3.1.20.

- ii. If ATD HIC data is not collected, a minimum pitch representing a pitch where an occupant would have no head contact with the seat in front must be given.

The following statements should also be included in all documents with regard to this limitation:

"This installation limitation is not applicable when the seat is installed in an aircraft that does not require compliance with FAR 25.562(c)(5)."

"The seats have been shown (*or have not been shown*) to meet the requirements of SAE AS8049A Subsections 3.1.15, 3.1.18, 3.2.1, and 3.2.2 regardless of seat pitch."

- iii. If ATD Femur Load data is not collected, a minimum pitch representing a pitch where an occupant would have no knee contact with the seat in front must be given.

The following statement should also be included in all documents with regard to this limitation:

"This installation limitation is not applicable when the seat is installed in an aircraft that does not require compliance with FAR 25.562(c)(6)."

- iv. If life vest retrieval has not been demonstrated for row-to-row seat pitch, a minimum seat pitch should not be given and the following statement should be included in the document:

"Life retrieval has been demonstrated per the requirements of SAE AS8049 Subsection 3.1.20 for a single seat only and has not been demonstrated for seats installed in repetitive rows. The installer is responsible for life vest retrieval compliance to the applicable airworthiness requirements for the specific seat installation configuration."

- v. The following statement must be included in the document:

"The seat installer must determine the requirements that are applicable for the aircraft in which the seat is to be installed and install the seat in accordance with the most critical limitation."

Example:

A seat may be approved under the TSO for seat pitches of 32" to 42" for HIC and Femur Load, 30" minimum pitch for egress, and 28" minimum pitch for life vest retrieval. If this seat were to be installed on an aircraft with HIC and Femur Load requirements in the certification basis, the minimum seat pitch could be no less than 32" in order to meet the installation limitations. If this seat were to be installed on an aircraft without HIC and Femur Load requirements in the certification basis, the minimum seat pitch could be 30 inches.

### 3.5 Seats Installed Behind Interior Components

- i. For seats intended to be installed behind an interior component, including a different model seat, or without a seat pitch limitation based on HIC/Femur Load, the 50<sup>th</sup> percentile ATD top of head and front of knee path applicable to that seat must be provided with the following statement:

"Seats installed behind an interior component or different model seat must be installed such that occupant head/knee contact with the interior/seat does not occur, or HIC does not exceed 1000 and Femur Load does not exceed 2250 lb, when considering the 50<sup>th</sup> percentile top of head and front of knee path data given in BBBBBB."

Where BBBBBB is either the reference to where the head/knee path data are in the Installation Instructions and Limitations document or reference to the report that contains them. If the reference is to a report, that report must be provided to the installer.

- ii. If ATD head path is not collected, a minimum setback limitation representing a setback where an occupant would have no head contact with another interior component must be given.

The following statement should also be included in all documents with regard to this limitation:

"This installation limitation is not applicable when the seat is installed in an aircraft that does not require compliance with FAR 25.562(c)(5)."

- iii. If ATD knee path is not collected, a minimum setback limitation representing a setback where an occupant would have no knee contact with another interior component must be given.

The following statement should also be included in all documents with regard to this limitation:

"This installation limitation is not applicable when the seat is installed in an aircraft that does not require compliance with FAR 25.562(c)(6)."

#### **4.0 Installation Instructions**

The instructions to properly install the seats, including attachment fitting torque, must be provided.

The following statement must be included in the document:

"The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those desiring to install this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards. TSO articles must be approved for installation. The article may be installed only if the installation is performed in accordance with 14 CFR Part 43 or the applicable airworthiness requirements."

#### **5.0 Data that may be used by the installer in approving an installation**

The following data has been included in the TSO data package and may be used by the installer for the purpose of installation approval:

##### **5.1 Seat Permanent Deformations (including Deployments)**

The seat permanent deformations recorded from static and dynamic tests must be reported. For each point on the seat for which permanent deformation is reported, the X, Y, Z deformation of the point shall be given. The sign convention for the deformations (+X, +Y, +Z) shall be clearly shown.

The number of points for which permanent deformation is reported, as a minimum, shall be such that the installer can evaluate the following:

- i) Seat forward/aft deformation.
- ii) Seat sideward deformation into longitudinal aisles up to 25 inches above the floor.
- iii) Seat sideward deformation into longitudinal aisles 25 inches and above the floor.
- iv) Seat and seat back deformations toward the exit for seats intended to be installed forward, adjacent, or aft of an exit or exit path (as required).

If seat back deformations from a row-to-row test are being reported, a description or figure of the test set-up should be reported (e.g., seat pitch, yaw angle and direction, ATD location).

Deployment of deployable items that occur as a result of dynamic testing must be reported. The distance that an item deployed should also be reported, if it did not fully deploy. If there were no deployments, it should be clearly stated that no deployments occurred.

## 5.2 Specific Installation Testing

Data regarding interior components included in the seat dynamic testing should be reported. These components may have been included in the dynamic test set-up for the purpose of evaluating HIC, Femur Load, or Lumbar Load. Alternatively, a rigid representation of the component(s) may have been used and data collected to show no contact occurs during the dynamic impact.

The appropriate data regarding the inclusion of these items in the test and the test results should be reported.

### Examples:

- 1) Actual or representative components are included in the test set-up. The data reported should be:
  - a) The part number(s) of the component(s), including revision level.
  - b) A figure of their placement in the test set-up relative to the seat.
  - c) Statement that the HIC/Femur Load/Lumbar Load criteria (as applicable) of TSO-C127a were met.
- 2) Rigid representation of the component is included in the test set-up. The data reported should be:
  - a) The dimensions of the rigid component.
  - b) A figure of its placement in the test set-up relative to the seat.
  - c) Statement that no contact with the component by the seat/ATD (as applicable) occurred.

## 5.3 Items that May be Installed on the Seats (Non-TSO Items)

Items that are installed on the seat that are not included in the TSO approved design may have been approved for installation on the seats for certain attributes as part of the TSO authorization. These items and the attributes that have been approved should be reported. The items that are reported may or may not be the actual production part number. The items that should be reported are those part numbers that the TSO data substantiates.

For example, if a representative part was used in dynamic testing and no additional rationale was made to justify the production part, then the representative part should be reported. If additional rationale was made to justify the production part, then the representative part and/or the production part should be reported.